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Quantum and the Abhidhamma

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Abstract

In the Theravāda Abhidhamma tradition, an atom is considered to be the smallest unit of matter which is an aggregate of a number of unitary material elements called as a "cluster of material elements" or "rūpa- kalāpa", where every cluster is delimited by an intervening space, so that they do not touch each other. However, according to the Sarvāstivāda tradition, an atom is considered to be the smallest unit of a single unitary material element and it is so minute that it actually lacks spatial dimension. This Buddhist concept of matter is very close to Einstein's concept of quantum as smallest unit of energy in the universe and also the modern theory of quarks which are hypothesized as mere geometrical points in space that make up the protons and neutrons of an atom. Though the study of the physical world was not the central focus of the traditional areas of learning and specialization in Buddhism, but the Buddhist scholars and contemplatives had developed views on matters related to the universe and its contents. These views were developed on pure logical and rational thinking and no rigorous methodology was applied for experimenting with the physical world.

1. Introduction

Modern physics bears the impact of Albert Einstein more than that of any other physicist. His theory of relativity with its profound modifications of the notions of space, time and gravitation had fundamentally changed and deepened our understanding of the physical and philosophical conception of the universe [5]. Though the study of the physical world was not the central focus of the traditional areas of learning and

specialization in Buddhism, but there are some striking similarities present between Buddhist and modern scientific views related to the concepts of time and space. The Buddhist scholars and contemplatives had developed views on matters related to the universe and its contents, which was based on pure logical and rational thinking and no rigorous methodology was applied for studying the physical world [12,13]. These phenomena were discussed in detail in the early Buddhism, the *Abhidhamma Pitaka*, the *Visuddhimagga*, the Pali commentaries, *Mahāvibhāṣā-śāstra*, the *Kālacackra Tantra* and in the literature on Buddhist epistemology [2,9].

2. Einstein's Theories on Quantum Physics and Relativity [1,5,10]

Albert Einstein had published some remarkable scientific papers addressing fundamental problems about the nature of energy, matter, motion, time and space. Some of his theories which could be viewed in light of the Abhidhamma concept of matter are as follows:

- In March 1905, Einstein created the **quantum theory of light**. This theory dealt with the idea that light exists as tiny packets, or particles, which he called photons. Einstein proposed that we live in a quantum universe, one built out of tiny, discrete chunks of energy and matter.

- During April and May 1905, Einstein published two new research papers. In one he invented a new method of counting and determining the size of the atoms or molecules in a given space and in the other he explains the phenomenon of Brownian motion. The net result was a **proof that atoms actually exist**. This brought an end to a millennia-old debate on the fundamental nature of the chemical elements.

3. Quantum and the Concept of Matter in Abhidhamma

The Abhidhamma analysis of matter assumes significance within framework of the Dhamma Theory. There are in all 28 rupa-dhammas or material elements which imply that 28 items into which material existence can be analyzed. These 28

material elements represent not only the matter that enters into the composition of living beings (organic matter), but also the matter that exists in the external world (inorganic matter). However, matter is defined as that which has the characteristic of "ruppana" which means the susceptibility to being modified or receptivity to change due to the impact of the contrary forces. This is also defined as "visaduppatti" or the "genesis of dissimilarity" or change. What is meant by change is the disappearance of one material element and the appearance of another material element in its place. So, the concept of change is not mere alteration between two stages of a single material element [6,7,10].

The four primary elements of matter recognized in Buddhism are: (a) Earth element – represents solidity and extension, (b) Water element – represents viscidity and liquidity, (c) Fire element – represents the temperature of cold and heat and (d) Air element – represents distension, fluctuation and mobility. These four primary elements are necessarily co-nascent and inseparable. These elements arise together, exist together and cease together and they cannot be separated from one another. Though there is no quantitative difference among these elements that enter into composition of material things, but the only difference is of intensity [6,10,11].

As defined in Theravāda Abhidhamma, the earth-element (pathavi-dhātu) has the characteristics of solidity and extension, which means the three dimensional spatial occupation. Our notion of a solid body is obtained when matter occupies the three dimensions of space. The earth-element which represents solidity and spatial extension is said to be present in every instance of matter. So, every instance of matter is characterized by solidity (whatever be the degree) and extension (whatever be the extent). This shows that the Theravāda Abhidhamma too, recognizes the Sarvāstivāda definition of matter in the concept of "pratighata" which is the resistance or impenetrability [6,10,11].

The Visuddhimagga states that in this body the earth-element (pathavi-dhātu) taken as reduced to fine dust and pounded to the size of atoms (paramāṇu) might amount to an

average dona-measure full, and that is held together by the water-element (āpo-dhātu) measuring half as much. According to the Sarvāstivāda tradition, an atom is considered to be the smallest unit of a single unitary material element and it is so minute that it actually lacks spatial dimension. This concept is very close to Einstein's concept of quantum as smallest unit of energy in the universe [1] and also the modern theory of "quarks" which are hypothesized as mere geometrical points in space that make up the protons and neutrons of an atom [6,10].

When any component of the body is reduced to the size of atoms, each atom in turn should consist of the same four inseparable primary elements. Thus, the concept of atoms (paramāṇu) logically points to be an aggregate of primary elements. This is identical with kalāpa, but in technical sense it means the smallest cluster of material elements. So, according to the Theravāda Abhidhamma tradition, an atom is an aggregate of a number of unitary material elements and is described not only as an atom (paramāṇu), but also as a "cluster of material elements" called "rūpa- kalāpa". Here, every "rūpa- kalāpa" is delimited by an intervening space, so that they do not touch each other. However, the attractive force of the air-element keeps the atoms together from escaping. From the point of view of modern science, this indicates the possibility of existence of some kind of an electro-magnetic force present between these elements which hold them in clusters without touching each other [6,10,11].

Though Einstein had earlier experimentally demonstrated the existence of atoms as smallest particles of matter, but later it was proved that atoms could be further divisible into its charged components of protons, electrons and neutrons which are separated from each other due to their respective electrical charges. Thus, the concept of atom perceived as "smallest cluster of material elements" in Theravāda Abhidhamma, also points to the concept of further divisibility of atoms[1]. The modern theory of "quarks" which are hypothesized as mere geometrical points in space that make up the protons and neutrons of an atom also exist as clusters to give definite shape to these structures [6,10].

4. Quantum Theory and the Buddhist Concept of Dynamic Flux

Abhidhamma considered events as space-time representations of a continuous dynamic flux. Nothing is considered to be static and permanent, but everything is in a state of constant change in our universe of experience. However, there is no single enduring changing entity, but there exist a series of momentary changes. The Buddha was often regarded as "Tathagata" which means "one who comes and goes thus". The Buddha gave this famous doctrine of momentariness (ksanikavada) in terms of "here and now" [12,13]. The Quantum field theory also considers physical phenomena as transient manifestations of an underlying fundamental unity. Following this concept of dynamic flux, Einstein had also demonstrated the spontaneous and random movements of atoms, called Brownian motion. The idea which could be drawn out from his observations is that there is nothing in a constant, static state in this universe. All the particles in this universe are in dynamic motion with relation to each other and their tendency to execute the random movements are restricted due to the strong gravitational and electromagnetic forces of each other [4,5]. The doctrine of the Buddha related to the Dependent Origination also supports this concept by considering everything in this universe that we are able to perceive though our sense organs are impermanent and are subjected to constant change from moment to moment. This is the Buddhist counterpart of the phenomenon of dynamic flux.

5. Abhidhamma Perspective on Einstein's Notion of Escape Velocity and Black Holes

Einstein proved the theory of escape velocity which is use in all astronomical studies of modern times. When any space shuttle is launched from the earth's surface, it must have an initial speed of at least 11 km/s (25,000 miles/hr). If the shuttle's launch speed exceeds this speed, it can escape Earth's gravitational field and make it into space. If the launch speed is less than this escape velocity, it will fall back to Earth. The

value of the escape velocity from a planet or star depends on its mass and radius. The escape velocity is directly proportional to mass but inversely proportional to the radius and volume of a substance. If a star is compressed to a smaller size without changing its mass, its escape velocity will increase. This is due to the fact that a greater speed is needed to escape the greater gravitational force on its surface as it is more densely compressed [1,4,5].

In the Theravāda Abhidhamma tradition, an atom is considered to be an aggregate of a number of unitary material elements called as a "cluster of material elements" or "rūpa-kalāpa". Here, every "rūpa-kalāpa" is delimited by an intervening space, so that they do not touch each other. However, the attractive force of air-element keeps the atoms together from escaping. From the point of view of modern science, this indicates the possibility of existence of some kind of an electro-magnetic force present between these elements which hold them in clusters without touching each other [6,10,11,12]. This Abhidhamma perception of non-collapsing clusters of material elements with the attractive force of air-element holding them in position, could define Einstein's concept of escape velocity of a non-collapsing celestial mass.

According to Einstein's special theory of relativity, the speed of light is the ultimate speed limit in the universe. Nothing can travel faster than light. Hence, when a star collapses to the point that its escape velocity exceeds the speed of light, *nothing* can escape, not even light. A black hole is simply a star that has collapsed so much that its escape velocity is greater than the speed of light. Traveling into a black hole is thus, the ultimate one way trip. There is no traveling back from it. This happens when the most massive stars, at the end of their lives, explode as supernovae. If the central core of the star left after the explosion is at least about 2 to 3 times as massive as the Sun, there is no force known to modern science that can resist the inward tug of gravity. It will continue to compress until it collapses into a black hole. Because no known force can stop the collapse, all the matter in what was once the star is compressed into a geometric point, it has a radius of zero. This point is called the singularity. The singularity has the same mass as the core of the star that

collapsed into the black hole, compressed into a radius and volume of zero. Hence it has an infinite density [4,5].

The distance from the singularity to where the escape velocity equals the speed of light is called the Schwarzschild radius or event horizon. The Schwarzschild radius of a black hole, ten times as massive as the Sun, is 30 kilometers. Schwarzschild predicted this effect from Einstein's general theory of relativity. Although nothing can escape from inside the event horizon, black holes don't automatically slurp up everything nearby. It is possible to orbit a black hole without falling in [1,5].

In the Sarvāstivāda Abhidhamma tradition, an atom is considered to be the smallest unit of a single unitary material element and it is so minute that it actually lacks spatial dimension. So, the Sarvāstivādins believe that an atom is devoid of parts and exempt from resistance or impenetrability. Keeping this concept in background, if we presume that atoms touch each other totally and without any intervening space in between, then they would all collapse into one and all would occupy the same locus [6,10,11]. This Abhidhamma concept of complete collapse of elementary particles of matter relates to the theory of origination of dimensionless dark holes with enormous celestial mass.

The concept of “emptiness” in Madhyamika tradition by Nagarjuna also suggests that except the “Nibbana” and “space”, whatever we perceive through our sense organs is virtual [2,8,12]. Though the dark holes have enormous celestial mass and gravitational force of attraction, but they lack dimension and are mere points in the universe. So, they could be regarded as dimensionless virtual mass. In spite of having real existence, they remain invisible to the human eye as they absorb all the light rays that fall on them and reflect none. We see only about 10% of the total mass of the clusters in the form of the individual galaxies in the clusters. The remaining 90% is dark matter. Since, the dark matter has immense mass and gravitational pull to trap all the light rays that fall on them and never reflect anything; they remain invisible to the human eye.

So, we might not be able to locate 90% of matter in the universe which are in the form of dark matter [5].

6. Einstein's Views on Energy for Expanding Universe

Einstein thought earlier that the space was not expanding, and he used in his calculations a factor named, "Cosmological Constant", to cancel the expansion effect. But later he changed his mind and supported the theory that expansion of the universe is really happening. He had proved this theory by demonstrating the shift of light towards the red spectrum to confirm this expansion of the universe. The universe is considered to have a constant amount of energy since the beginning and as mass is a concentrated form of energy, what really happens is a change of energy from one type to another [4,5]. To explain the expansion of the universe, there is the theory of spontaneous generation of matter, which means, mass appears from energy to fill the space so as to contradict the "Big Bang" theory. Scientists do not really know why space is expanding. However, measurements and observations are best explained by considering the universe to be expanding. Though there are a variety of possible explanations put forward by the modern scientists, but we do not know for certain if any of these are correct [5,8,12].

In Theravāda Abhidhamma, an atom is considered to be an aggregate of a number of unitary material elements and is described as a "cluster of material elements" called "rūpa-kalāpa". Every "rūpa-kalāpa" is delimited by an intervening space, so that they do not touch each other. The attractive force of the air-element keeps the atoms together. But there is no mention of how close these material elements are to each other and what is the dimension of their intervening space [6,10,11]. However, the very fact that they are held in clusters, with each element separated from each other; from the point of view of modern science, this indicates the possibility of existence of some kind of an electro-magnetic force present between these elements. If this phenomenon is true then the strength of this force could explain the possible reasons for expansion or collapse of the universe.

7. Conclusion

Albert Einstein was very much influenced by the Buddhist doctrines related to the concepts of absence of any Creator God, absence of any soul or self (anatta), Dependent Origination (paticcasamuppada), impermanence (anicca) and the emphasis on practicing compassion with moral-driven, volitional activities (kamma) [3,5]. He had also predicted that the religion of the future will be a "cosmic religion". It would transcend personal God and avoid dogma and theology. Covering both the natural and the spiritual, it should be based on a religious sense arising from the experience of all things natural and spiritual as a meaningful unity. In his opinion, Buddhism answers this description. Buddhism has the characteristics of what would be expected in a cosmic religion for the future: It transcends a personal God, avoids dogmas and theology; it covers both the natural and spiritual; and it is based on a religious sense aspiring from the experience of all things, natural and spiritual, as a meaningful unity. So, "**if there is any religion that would cope with modern scientific needs, it would be Buddhism**" [3].

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